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ROCKS and MINERALS

A Magazine for Mineralogist, Geologist and Collector . . .

. . MARCH, 1938 . .

Vol. 13 No. 3 TWENTY-FIVE CENTS Whole No. 80

THE ROCKS AND MINERALS ASSOCIATION

PEEKSKILL, N. Y.

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Organized in 1928 for the increase and dissemination of mineralogic knowledge.

To stimulate public interest in geology and mineralogy and to endeavor to have courses in these subjects introduced in the curricula of the public school systems; to revive a general interest in minerals and mineral collecting; to instruct beginners as to how a collection can be made and cared for; to keep an accurate and permanent record of all mineral localities and minerals found there and to print same for distribution; to encourage the search for new minerals that have not yet been discovered; and to endeavor to secure the practical conservation of mineral localities and unusual rock formations.

Ever since its foundation in 1928, the Rocks and Minerals Association has done much to promote the interest in mineralogy. It has sponsored outings, expeditions, formations of mineralogical clubs and the printing of many articles that have been a distinct contribution to mineralogy.

Those of our readers who are members of the Association can rightly feel that they too were sponsors of these many achievements that have helped to give mineralogy a national recognition. Among your friends there must be many who would like to have a part in the Association's work—to share with you the personal satisfaction, the pleasure, and the benefits of membership. Will you give your friends this opportunity to join the Association by nominating them for membership? A nomination blank will be found elsewhere in this issue.

Each new member helps to extend the Association's activities—helps to make your magazine larger,better, and more interesting, and above all assists in the dissemination of mineralogical knowledge.

Some advantages of membership: All members in good standing receive:

(1) **Rocks and Minerals,** a monthly magazine. (2) A member's identification card that secures the privileges of many mines, quarries, clubs, societies, museums, libraries. (3) The right to participate in outings and meetings arranged by the Association. (4) The right to display a certificate of membership and to place after their names a designation indicating their membership or to advertise membership on stationary, etc. (5) The distinction and the endorsement which comes from membership in the world's largest mineralogical society.

The following clubs are affiliated with the Rocks and Minerals Association:

Canon City Geology Club, F. C. Kessler, Sec., Canon City, Colo.

National Geological Club, Mrs. D. P. Stockwell, Pres., Mt. Olympus, Kimmswick, Mo.

Reno Rocks and Minerals Study Club, Mrs. Rader L. Thompson, Sec., R.F.D. 1, Box 225A, Reno, Nev.

Rocks and Minerals Association of North Jersey, Dover, N. J.

Queens Mineral Society, Miss Bernadette Reis, Sec., 10314-97th Ave., Ozone Park, L.I., N.Y.

ROCKS and MINERALS

PUBLISHED MONTHLY

Edited and Published by PETER ZODAC

MARCH 1938

CONTENTS FOR MARCH, 1938.

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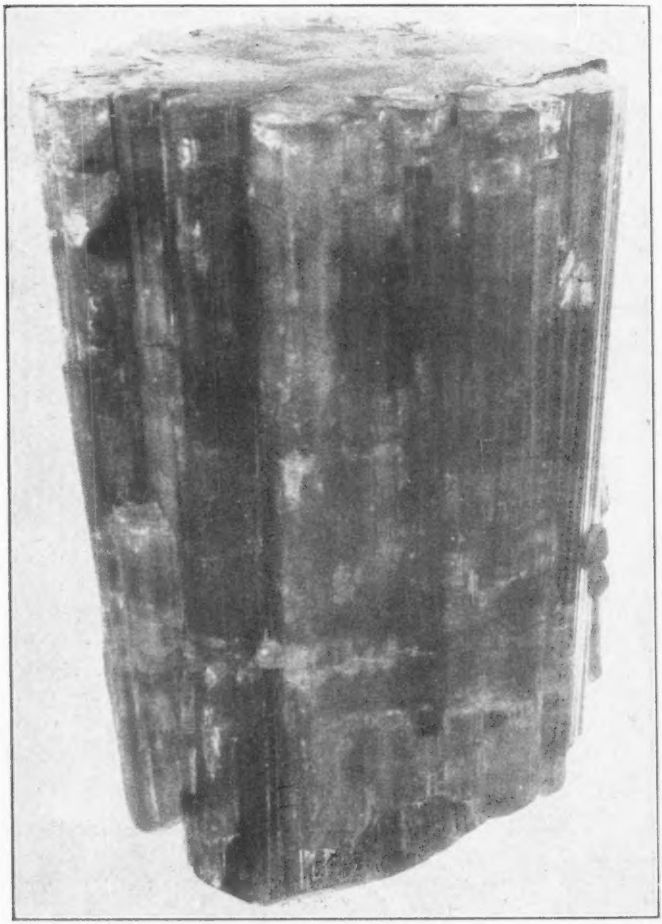
The Official Journal of the Rocks and Minerals Association



Courtesy U. S. National Museum.

TOURMALINE VAR. RUBELLITE

(Large Crystal)

MESA GRANDE, CALIF.

TOURMALINE

Tourmaline is a remarkable mineral in a number of ways. Aside from its varied forms as massive, columnar, crystal or its wide range of colors as black, blue, green, pink, red, white and colorless which many minerals possess, it is the coloring of the crystals especially that sets off tourmaline as a unique mineral. A crystal of tourmaline does not possess one color, generally, as is so common with crystals, but it may be bi-colored, tri-colored, etc. It may be green at one end and pink at the other with a colorless band in between. Its exterior surface may be entirely green while its interior is pink (this type is known as watermelon tourmaline). Or it can occur in various other shades and combinations.

A cross-section of a typical tourmaline crystal shows it to be three, six or nine-sided, spherically.

Commonly, when in well defined crystals, its two terminations are unlike. Such crystals possess pyroelectricity. If such a crystal is gently heated by friction, by the sun, or by a flame, one termination will attract light particles like small bits of tissue paper, while the other end will repel them.

Tourmaline is commonly found in opaque crystals, brown or black in color and especially the latter. Black tourmaline so closely resembles black hornblende that when crystal faces are lacking it is sometimes difficult to differentiate between the two. Tourmalines are generally slender, lustrous, brittle so that they often appear shattered, and are especially common in quartz and muscovite. Hornblendes are commonly short and stout, dull, cleavable with smooth faces, and are especially associated with feldspars. Hornblende has a hardness of 5-6 and tourmaline 7-7.5 but due to its brittleness it is often difficult to determine the hardness of tourmaline.

Blue tourmaline is called indicolite or sometimes indigolite; pink is rubellite, and colorless is achroite.

Two states of the Union, Maine and California, are especially noted for their remarkable gem tourmalines. The great tourmaline locality of Maine is Mt. Mica, about a mile east of the village of Paris in Oxford County, which in turn is in the southwestern part of the state. The locality was discovered in 1820 by two young amateur collectors, Elijah L. Hamlin and Ezekiel Holmes. Since that time, thousands of fine crystals of green, pink, blue and even colorless, have been taken out of that famous hill to enrich museums and private collections all over the world. Many more crystals have been cut into gems and distributed by dealers and jewelers.

The tourmaline district of California is in San Diego County, in the southwestern part of the state. A series of pegmatite dikes in the northwestern part of the county run northward from Mesa Grande through Pala and into the adjacent Riverside County. It is in these dikes that magnificent gem tourmalines occur of many shades as pink, green, blue, violet and colorless. These too have been scattered throughout the world to enrich collections or be cut into gems.

Very fine tourmalines have been found at Goshen and Chesterfield, Mass.; Strickland quarry near Portland and Gillette quarry on Haddam Neck, both in Connecticut. At the latter quarry, "darning needle tourmalines" have often been found. These would be up to 4 or 5 inches in length and minutely thin—just like a darning needle—and commonly of green color.

Magnificent tourmalines of gem quality are also found in Madagascar, Brazil, Siberia and Ceylon.

Years ago, black tourmalines were called **schorl**, a name derived either from Schorlaw, a village in Saxony, Germany, where fine crystals had been found, or from the Swedish word **Skorl**, brittle, as the mineral is very brittle.

Tourmaline received its name from the Cingalese word, **turmali**, Cingalese is a dialect used on the Island of Ceylon.

CHIPS FROM THE QUARRY

PETER ZODAC

We Are Grateful

On Thurs., Feb. 3rd, 1938, we attended a meeting of the Philadelphia Mineralogical Society. We were very cordially received, in fact some of the members especially Mr. Charles R. Toothaker, Curator of the Commercial Museum and Mr. Samuel G. Gordon, Associate Curator of Mineralogy of the Philadelphia Academy of Sciences, went out of their way to make our visit a most enjoyable one.

But the one moment which gave us our greatest thrill was near the close of the meeting when it seemed as if every member of the Society—one by one—jumped up to heartily endorse **Rocks and Minerals** as the one mineralogical magazine worthy of their support. Mr. Harry W. Trudell, President of the Society, started the avalance of endorsements to be followed by Messrs. Morrell G. Baldwin, Charles R. Toothaker, Edmund H. Cienkowski, Mrs. W. Hersey Thomas—but by this time our ears had become so red and our mind so confused that we could not note further the kind and generous friends who were commending the magazine so highly. Never in all our experiences had we ever heard **Rocks and Minerals** so enthusiastically endorsed and acclaimed as on this memorable night.

We are deeply grateful to the members of the Philadelphia Mineralogical Society for this very cordial manifestation of their interest and support of **Rocks and Minerals.** Will they kindly accept our most appreciative thanks?

We are also grateful to these members of the Rocks and Minerals Association who made special efforts to meet us either at the above meeting or at Mr. Arthur Montgomery's very fine display of minerals at the Robert Morris Hotel. It was a real pleasure in meeting these members, many of whom were old friends, and we hope to see them again in the near future.

While in Philadelphia, Mr. Charles Toothaker induced us to visit his home where we were shown his very fine collection of minerals. "Very fine" are but mild words when describing his collection because every item is a CHOICE specimen. They literally took our breath away.

"Why," we gasped, "they are better than any to be seen in a museum."

"Well," replied Mr. Toothaker, nonchalantly," if a specimen that is offered me for sale is not better than that in a museum, I do not want it for my collection."

Before leaving, Mr. Toothaker presented us with some of his duplicates. They are just "trash" he told us, and if of no use to you throw them away or else give them to some youngster. We shall never part with them as they now form some of our prized specimens. We would be grateful indeed if other collectors would send us similar "trash".

Peter Zodac

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WHOLE NO. 80

HOW OLD IS THE EARTH?

By RONALD L. IVES

"In the beginning, God created the heavens and earth—" A few cynics opine that the Devil had a hand in it too—the world's such an imperfect place—but most of us agree that it was created. The exact date, and the divine (or diabolic) **modus** operandi, neither one very clearly revealed in scripture, have been puzzling geologists ever since a certain satirical member of the genus **Homo** named his species **sapiens.** The answer is still uncertain, but the earth is now generally believed to be more than one billion years old—probably much more.

Before the days of scientific investigation, estimates of the age of the earth ran from about 6,000 years to infinity, the sources of data being scriptural, conjectural and metaphysical. About 1650, after a study of Hebrew chronology, the good Bishop Usher set the day of creation as October 14, 4004 B.C. Archeologists now find that there were quite advanced cultures existing as long ago as 5600 B.C., and it has been concluded from this, and other data, that the good bishop made a slight mistake somewhere. However, his date of creation was honestly arrived at—it was a good try, despite the probable error of a billion years or so.

American Indians, unable to count in thousands, describe events that happened "hundreds and hundreds and hundreds of years ago, when God was a little boy—". As they have no recollection of the divine coming-of-age, this doesn't help us any more than Bishop Usher's slightly erroneous estimate.

According to some oriental religions, the earth is very old—without beginning, and without end—and man has inhabited it for many cycles, each untold milenniums in length. Strangely, some of the (perhaps unauthorized) disciples of Einstein believe the same thing—that time is a circle, or perhaps a spiral—the years go in at this end, and the ages come out here. Perhaps Einstein and the Brahmins are right—

Only a few generations ago, the answers to scientific problems were arrived at by sitting in some monastery and thinking about them. As a result of this method of investigation, we have some very weird writings on the natural sciences, and some very scholarly theses on the relation of analytic geometry to the doctrine of infant damnation. The only real fault with this method was that it didn't work. About 150 years ago, a new and very subversive idea crept into the natural sciences. The way to solve problems was to go and look! Despite very determined opposition, this method was adopted, and it worked. Soon, men were questioning Bishop Usher's estimate of the age of the earth, and many of them left this mundane sphere in a blaze of glory—at the stake. Somehow, though, cremating a few careful thinkers didn't help much. It was still pretty hard to fit all the known geological occurrences into a mere 6,000 years. Hugh Miller studied the "Old Red Sandstone" of England, and others found more sediments over them. Could all of these have been laid down in a mere 6,000

years? The man who said they couldn't risked eternal damnation, but a few took the chance. Geology books as late as the year 1825 devoted long chapters to the reconciliation of Geology with Genesis. Somehow, they're not very convincing.

New ideas, perhaps strengthened by opposition and oppression, spread in scientific circles. The volcanic theory offered a true solution of the problem of the age of the earth. It should be possible to calculate from the rate of cooling, just how long it took the earth to solidify, and how long had elapsed since then. Lord Kelvin, after careful calculation, decided that not more than forty million years had elapsed since the earth was in a molten state. It was a long jump from the 6,000 years of Usher's estimate to the 40,000,000 years of Kelvin's, but, in the years between 1650 and 1850, geologic knowledge had grown so rapidly that even 40,000,000 years was too short a time for known terrestrial happenings. Besides, Kelvin's theory of a cooling earth also assumed a cooling sun, and predicted the end of mankind. Instead of advancing to a higher and higher state, as predicted by the theory of evolution, man was doomed to freeze, and in the not very distant future. The literature of the latter part of the nineteenth century is full of references to "the group of miserable survivors cowering in darkness over the dying embers of the last fuel before everything went out in everlasting night". How many years were left for mankind? Kelvin's calculations, based on the theory of a cooling earth, were indisputable. Kelvin was a competent worker, his explanations were clear, anyone could repeat his calculation and get the same answer. He didn't make any mistakes in arithmetic. Others calculated the age of the earth, and of the sun. Kant had assumed that the sun was burning. When physics had advanced to the point where the life of the sun could be calculated, it was found that it could only last—as a burning mass—for about 1,000 years! That wasn't even long enough to satisfy Bishop Usher's estimate of earth age! Perhaps the sun wasn't burning, even if astronomers could see flames shooting out from the surface. Heat was being produced by some other means—but what? Compression? No, that wouldn't give enough time. Transmutation of elements? Eddington calculated that if elements were being transmuted, "the past and future life of the radiant sun is limited to 15,000 million years". That is a much longer time than geologists need to account for all terrestrial changes. But, while this figure is very great, modern physics gives us another theory, and an even greater figure—if matter is being transformed into energy, an occurrence thoroughly in accord with modern physical theory, then the present rate of loss of mass of the sun is about **one percent in 150,000,000,000 years.** Man has no further worries of the sun going cold at any time in the near future, not even if the near future is figured in geologic time!

But what of the cooling earth? Was not the earth molten at one time, and is it not cooling off at present? Perhaps Kelvin was right, after all. But someone found, in the oldest rocks known, a record of an intense ice age! Further studies showed that at no time since the beginning of the sedimentary record was all of the water on earth frozen, nor was it ever too hot to support some form of life! Then, it would seem that the earth wasn't cooling steadily. Today, geologists believe that the average temperature of the earth throughout geologic time was a little warmer than present temperatures. True, there have been ice ages, but there have also been warm periods to offset them. Man seems to have evolved during a series of relatively recent cold spells. These discoveries relegated Kelvin's estimate of earth age to the same limbo as Usher's—thoroughly honest attempts, perhaps the best that could be made under the circumstances, but not supported by later discoveries. There must be some other way. There is—about a dozen of them!

Astronomers tried their hand, and secured several figures, all of them of great

probable accuracy, and most of them agreeing rather closely. Theoretically, the solar system was created by the disruption of a star, at some remote time in the past. This, according to theory, most probably happened in or near the milky way. The solar system is moving away from that location, and the rate of motion is known. Now assuming that this rate of motion has been uniform, we can calculate the time elapsed since the parent star has been uniform, we can calculate the time elapsed since the parent star was was disrupted. This probably occurred more than 1,000,000,000 years ago, and less than 5,000,000,000 years ago.

Another method, based on astronomy, and also on physics, uses the theory that the moon was at one time a part of the earth, and was torn away from it. Tidal friction is slowing the moon down, and causing it to move away—at a very slow, but calculable, rate. By a rather involved series of calculations, it has been found that the separation of earth and moon took place from 2,000,000,000 to 3,-000,000,000 years ago. Is this figure correct? Is the theory upon which the calculations are based correct? Several other calculations, based upon more obscure astronomical phenomena, give us figures for earth age which all approach 2,500,000,000 years. These figures, if correct—and they are based on theories that seem to be correct—give us the age of the planet earth, and not the date of the beginning of the sedimentary record.

While astronomers were working with celestial mechanics, the geologists were not idle; in fact, they were working overtime. Perhaps, they reasoned, if the annual amount of salt added to the seas, the salinity of these seas, and their volume, was known, the age of the earth could be calculated. In 1899 the necessary data were at hand—the total sodium content of the oceans was about 12,600,-000,000 million tons, and each year, about 156,000,000 tons were being added. This gave the age of the earth as 81,000,000 years—or did it? Perhaps the rate of sodium deposition had not been uniform during all of geologic time—perhaps the oceans had been saline to begin with—perhaps the present rate of deposition is more rapid than it should be—perhaps—. After a number of corrections, a new calculation gave the oceans a minimum age of 330,000,000 years. This is also a minimum age for an earth **cool enough to have oceans.** Geologists today are prone to insert a boogle factor into the calculations, which, if this factor is five, gives the earth an age of about 1,500,000,000 years. Each geologist who uses this method has his own private patented boogle factor, composed of the amount of salt withdrawn from the oceans to make the salt domes of the Gulf Coast, that contained in salt lakes, and even the amount used in salting down pork! Careful workers, who don't like to use boogle factors in their calculations, doubt the accuracy of this figure. Perhaps some other method. . . .

While some geologists were measuring the salinity of sea water, others, equally competent, were trying to determine the age of the earth by other methods. Perhaps, if the rate of sedimentation was known, and the thickness of all the sediments laid down throughout geologic time. . . . If the maximum thicknesses of the sediments laid down during each geologic epoch are added together, we find that something approaching 100 miles of sediments have been deposited since geologic history began. Not all of this thickness is present in any one locality; in fact, localities where the entire series of beds, from Pre-Cambrian to Recent, is present are unknown. The deposition of sediments has been aptly compared to the falling of sands in an hour glass. Perhaps the periods of non-deposition represent times when the sands had run completely through, before some celestial timekeeper turned the glass? What about the rates of deposition in the past? De Geer and Antevs, working on glacial clays, have found annual bands extending back, in an almost unbroken series, for more than 4,000 years. Perhaps these would supply the necessary clue? No, glacial deposits are abnormal, as are ice ages, and represent a negligable fraction of geologic time. They give no clue as to **average** conditions during the geologic past. Perhaps—but, after years of careful work,

by dozens of experts, the results were inconclusive. As in the case of oceanic salinity, boogle factors were resorted to. The sedimentary record, if carefully interpreted, and not corrected for boogle factors, tells us only that the world is probably more than 300,000,000 years old. The great gaps present in the sedimentary record make us reasonably certain that this is too small a figure, but supply no good clue to the real figure. Certain geologic problems can be solved by a study of sedimentation, but the age of the earth is not one of them. Even if we could fill in all of the gaps in the sedimentary record, we still coudn't find the age of the earth—from present knowledge. One end of the yardstick is missing. The thickness of the oldest rocks—the Archean—is unknown. Nobody has ever found the basal Archean—and then, what underlies it? Perhaps the oldest materials have been fused by the internal heat and pressure of the earth, their records of sedimentation forever obliterated? The problem of the fate of the oldest terrestrial sediments becomes lost in a haze of theory and speculation about the interior of the earth. Some other method . . . .

Perhaps, geologists reasoned, there was some regular system of mountain building and leveling. Perhaps some internal earth force, or combination of forces, caused the upheaval of mountains at regular intervals. Perhaps, also, the minor epochs, of which there have been about twenty since life appeared on earth, were of equal length. Now, if the length of one of these epochs could be determined. . . . G. K. Gilbert, while studying the plains of Colorado, found something that might help. In the Upper Cretaceous beds—the Benton, Niobrara, and Pierre, composed of interbedded limestones and shales—he found certain recurrent changes of deposition. Now, what in nature would recur many times—tides?—sunspots?—no, these had too short a period. What, then? Only the precession of the equinoxes, which completes one cycle in about 21,000 years. Nothing else could possibly fit. Was that the right answer, or was it a coincidence, seemingly correct, but actually fallacious? After a long study, during which he determined that the shales were deposited three times as fast as the limestones, a very reasonable figure, he found that the deposition of these beds, which are only about two thirds of the total Upper Cretaceous thickness, took about twenty million years. The deposition of the whole of the Upper Cretaceous thickness, then, should have taken about thirty million years. Was this reasonable? Yes. Was it correct? Gilbert had no way of finding out, but today, with greater knowledge, we have some fairly conclusive proof that Gilbert wasn't far wrong. Other determinations, based on erosion and sedimentation during other epochs of earth history, gave similar results. Perhaps, then, all of the epochs were 30,000,000 years long, more or less. If so, how old is the earth? Well, on this basis, at least 600,000,000 years have passed since the beginning of Cambrian time—when life first appeared on earth. But, there was Pre-Cambrian time to consider, and that had never been divided into epochs—there wasn't enough evidence to justify division. How long was the Pre-Cambrian? Evidence of at least four periods of mountain building has been found in the Pre-Cambrian. Perhaps these were spaced about 150,000,000 years apart, like those of more recent time? If so, the duration of Pre-Cambrian was **at least** 600,000,000 years. There being no known exposure of the basal Pre-Cambrian, this figure is a minimum. The age of the earth, then, on this basis, is **at least** 1,200,000,000 years **since sedimentation began.** This age, based on a theory of rhythms, partially supported by geologic evidence, was arrived at without the use of boogle factors. It looks reasonable. Certainly, **if** the theory is valid, the age is correct. But is the theory valid? Only another age determination, using different data, would tell. But what other method. . . .?

Pierre and Marie Curie, during their long and thorough study of radioactivity, found the only remaining good clue to

earth age. They found that Uranium broke down, at a measurable, but very slow, rate, into Radium, which further disintegrated, giving, as end products, Helium, and an isotope of Lead with an atomic weight of 206. Let us call this simply 'Lead 206'. Now, if the amount of Helium in a mineral was known, and the amount formed in a year by radioactive disintegration was known, the length of time during which the mineral existed could be determined. Perhaps the age of the earth could be found by some modification of this method? It could. Thorianite, a mineral from Ceylon, contained 280 million times as much Helium as it generated in a year. Therefore, the mineral had existed 280 million years? Perhaps, but how much Helium had escaped? There was no telling. Perhaps this approach wasn't so good, after all. It did give, however, a minimum age for the mineral. But how much older than 280 million years was it?

Lead 206, the other end product of radioactive disintegration, doesn't leak away as easily as Helium gas. Perhaps, if the amount of Lead 206 in a mineral is measured, and the annual production of Lead 206 determined, the age of the mineral could be found with considerable accuracy. This will be true only if all of the Lead 206 in the mineral is derived from the mineral itself, and all of it is still present at the time of the analysis, and if the rate of radioactive disintegration has been constant throughout geologic time. Experiments with other radioactive elements have given us other clues by which we can determine the age of minerals. A few complications have arisen, and are still not satisfactorily solved, but the dates determined by the "radioactive clock" are given general credence. A great number of analyses have been made, and the age of the oldest rocks has been determined as **more than** 1,250,000,000 years. By means of a very complicated study, based on radioactive disintegration, the **maximum** age of the earth has been determined as 3,000,000,000 years.

The various methods of determining the age of the earth give us a number of ages which, while carefully worked out, do not agree. However, the various astronomical methods give one approximate age, while the geological methods give us two agreeing minimum ages and one probable maximum age for sediments. Radioactivity investigations give us one figure for the age of the oldest rocks, and another for the earth. What do all these mean, if anything, and why the discrepancy? Let us review the figures. Astronomy tells us that the earth is about 2,500,000,000 years old (plus or minus a few hundred million years). Geology tells us that the sediments are more than 300,000,000 years old (excluding boogle factors), probably much more, ano perhaps as much as 1,200,000,000 years old. The radioactive clock tells us that the oldest rocks are about 1,250,000,000 years old, and the earth not more than 3,000,000,000 years old. Now, is there really a great discrepancy in the figure? Both astronomy and radioactivity tell us that the Earth is about 2,500,000,000 years old. The two methods check quite closely. Let us assume that they are correct. Both geology and radioactivity tell us that the oldest rocks are about 1,250,000,000 years old. Again, there is a close check, and a probability of correctness. Is there still a discrepancy? Some 1,250,000,000 years are not accounted for. What happened during this time—the time between creation and the beginning of sedimentation? Was the Earth too hot for the present processes of erosion and sedimentation to take place? Certainly, we couldn't have rivers and seas if all the terrestrial waters were steam. Some of the many theories of earth origin say that this was so. Perhaps, during this time, Earth was "getting organized". Certainly, we have no record of the first half of Earth's existence. Has the record been obliterated by later events, or haven't we looked in the right places for it, or do we have the record already, without knowing it?

Now, we have determined the age of the Earth by several methods, and out of this determination has come some knowledge of earth history. Are these ages accurate, or will they become, in the future, the subject of indulgent smiles? Are any of our estimates right, or are they all based on false premises, like Usher's and Kelvin's? We think these figures are approximately correct, but they all need further checking. Some other method. . . .

FLUORESCENT PAGES CREATE SENSATION

The four pages in the last issue (Feb.) of ROCKS and MINERALS that were printed in fluorescent ink created a sensation everywhere. Telegrams, letters, and personal congratulations poured in on us from all directions while newspapers all over the country carried many interesting accounts about the magazine that was printed in "Glowing Ink".

Perhaps nothing pleased us so much as the reports from curators of Children's Museums. Once the youngsters discovered the fluorescent pages of the magazine, "riots" took place almost immediately in trying to test the pages under various ultra-violet lamps.

We are very glad that this special feature of ROCKS and MINERALS made such a hit with our readers and we shall try to have other interesting features for the magazine. Judging from the many comments expressed by readers on recent issues of the magazine, the consensus of opinion is—what will ROCKS and MINERALS put out next?

VARNI TO EXHIBIT

The Stephen Varni Co. has been invited to exhibit at the Bloomingdale Brothers Department Store, Lexington Ave. at 59th St., New York City, (second largest department store in the city) during the "Made in America Week", from March 7th to 12th, inc. The Varni Co. will exhibit the Johns Gem Cutting Machine—made in America and will be operated by an American who will cut only American stones.

The Varni Co. extends a cordial invitation to all members of the Rocks and Minerals Association to visit their exhibit duirng the "Made in America Week".

MOONSTONE

Aloof, remote
From other gems,
You were not made
For diadems;
Removed from ruby's
Brilliancy,
As rose from wood
Anemone;
Pure, with limpid
Misty light,
Owning allegiance
To the night;
Pale as visions,
Icy-cool,
As the depths
Of frosted pool;
In your heart,
Still, serene,
A spray of moonbeams,
Opaline;
Dawns and sunsets,
You enlink,
Poised forever
On the brink
Of dreams, illusions,
Not fulfilled,
That fire and rainbows
You could yield,
Could release
Before our eyes,
Iridescent
Dragon-flies.

—Mary McClelland.

THE MINERALS OF A TRAP ROCK QUARRY AT SUMMIT, N. J.

By M. ALLEN NORTHUP
Jersey City, N. J.

The locality under discussion, which is known as the Commonwealth quarry, is located between the towns of Summit and Springfield in Morris County, N. J. about a mile and a half south east of the former town on east Orchard street which turns off Morris ave towards Westfield. As it extends quite a way along the side of a prominent hill, it may be easily seen from any point on that side of Summit, or from the valley below.

Work has been going on at this quarry for thirty-five years, but most actively since it was taken over about ten years ago by the North Jersey Quarry Co. and Associated Companies. Entrance may be gained by applying at the office where the visitor is asked to sign a release of his liability rights in case of accident. However, permission is not granted to enter parts of the quarry where work is going on, so that the best time to collect minerals is late Saturday afternoon or Sunday if permission can be obtained before hand.

Geologically the quarry is located in a part of the second Watchung mountain which is composed of basalt contemporary with that at Paterson, N. J. as well as the Palisade diabase. As this rock makes excellent road metal and concrete filler it is extensively quarried all over the northeastern part of the state. Although the associated minerals are not usually as fine as the world famous ones from Paterson and there are many barren quarries, any excavation in this formation is worth a visit.

There are three closely grouped quarries at the Summit locality, the largest of which, known as No. 1, runs along the hill in a southwesterly direction for about a quarter of a mile. This hole is quite shallow due to an underlying layer of a very porous green rock much too soft for road metal. As this green rock is a great nuisance to the quarrymen, it is only taken out when a ridge of it extends far enough up into the hard trap rock to be broken down in blasting. Then it is dumped anywhere out of the way. It is most productive of minerals, containing much Albite, Stilbite and Heulandite as well as traces of other minerals. There are few mineral cavities in the solid trap rock above or beyond this formation, the main mineral occurrences being in small tubes or as drusy coatings and fillings in jointing cracks.

The northeastern or No. 2 quarry is across the road at a lower level in the hill. It is pretty generally unproductive of minerals, the rock being very solid basalt of a quality to delight the hearts of all good quarrymen. However, as the floor of this hole is used as a dump for unwanted rock from the other quarries it is not a bad place to collect. What few minerals occur in the rock of the quarry itself are drusy and much flattened. In one side a ridge of crumbly red sandstone extends up in to the basalt for some distance. This contains no minerals except a few small pockets of Heulandite and chloritic matter near the contact. It is probably an ancient hill over which the original hot basalt flowed.

The middle quarry, known as No. 3, is only a small hole at the top of the hill. It was opened last summer but work was soon halted, which is too bad because it promised to be the best yet from the collector's standpoint. Prehnite, Datolite, Calcite, and Chalcedony occur here in cavities similar to those at Paterson, deep in the rock. There are also a few large pockets lined with an inch or two of hard vesicular rock containing no minerals at all, or only a

few Calcite crystals. Farther out towards the main quarry and nearer the surface there are numerous small cavities filled with Albite, green chloritic rock, and a little Stilbite suggestive of the formation in the floor of the former and possibly connected with it.

As the mode of formation of his specimens is usually of interest to the collector, a word about that phase of the subject seems in order. All of the collectable minerals at this locality as well as at Paterson and other places in the Watchung basalt are of secondary origin. The accepted theory is that the rock was formed as a huge lava flow which welled up out of the earth in semi-arid Triassic time. In places where it flowed over more or less alkaline lakes much alteration and stirring up of the rock took place with the formation of Quartz, Albite, and other minerals in the bubble holes thus produced, and the introduction of Anhydrite and Glauberite from the lake salts. These last survive as well-shaped cavities in more resistant minerals that formed around them later on. Later the action of circulating ground waters on these earlier minerals produced the zeolites and other minerals. In places like No. 1 quarry at Summit, the lava evidently flowed into a large body of water, causing a gigantic blow out, very deep changes in the rock, and the formation of much Albite. At No. 3 quarry the action was more like that at Paterson, producing nice bubble holes in nearly unaltered rock, and forming minerals like Prehnite. At No. 2 quarry, on the other hand, the lava flowed over a dry sandstone hill and practically no minerals were formed except those that ground water deposited in the cracks later on.

The minerals found at this locality are as follows:

HEULANDITE: Brilliant crystals up to ¼" in irregular pockets in the green stone of No. 1 quarry. Abundant.

STILBITE: Yellowish glistening radiated masses up to 2" in diameter. Also sheaf like aggregates and rarely in groups and chains of little white globules about ⅛" in diameter. Fine prismatic or bladed crystals projecting from green stone or lining pock- cabinet specimens are not readily obtainable, but a few have been found in the green stone of No. 1 quarry.

ALBITE: An unusual low temperature form of this mineral consisting of very numerous little white or pink prismatic or bladed crystals projecting from green stone or lining pockets in it. Most abundant at No. 1 quarry.

POTASH FELDSPAR: Minute yellowish crystals of typical feldspar form associated with pink Albite from No. 1 quarry are either Orthoclase or Microcline.

PREHNITE: Groups of small globules, often separated from each other, and varying from white to deep green occur in the bubble holes of No. 3 quarry. A rare form consists of crusts of very small crystals on jointing planes. Specimens of any form as large as 2x2 are unusual.

DATOLITE: Encrustations of very small salty looking crystals on Prehnite. More rarely as larger crystals lining cavities at No. 3 quarry, and occasionally filling such cavities with a white, opaque, fine granular mixture with Chalcedony, or in the middle of almost colorless lumps of Agate.

APOPHYLLITE: Encrustations of tiny glass-clear crystals, more rarely up to 1" long in cavities of No. 3 quarry. The common form is a combination of prism and pyramid of opposite order, with the basal pinacoid generally small.

STEVENSITE: A pinkish white opaque altered form of Pectolite occurs as flattened wheel like forms in jointing planes at No. 1 and No. 2 quarries, or as large radiating more massive groups at No. 1.

NATROLITE: One specimen of tiny prismatic crystals terminated by low pyramids was found in the wall of

No. 1 quarry. Also as cleavable massive forms, usually opaque white outside and transparent within. The cleavage is perfect prismatic at an angle of almost 90 degrees.

CHABAZITE: Very poorly crystallized specimens of a light pink color in trap rock at No. 1 quarry.

LAUMONTITE: Small groups of radiating prismatic crystals—white, opaque and very fragile are associated with Stilbite in the green stone of No. 1 quarry.

CALCITE: Clear rhombohedrons up to 1" long at No. 3 quarry. Small crystals of varied habit occur at all quarries in cavities in trap rock and green stone, and filling jointing cracks. Cavities lined with little deep brown brilliant Calcite crystals on Albite were found at No. 1 quarry. These consist of two generations with an intervening layer of iron oxide which produced the color.

ARAGONITE: Rounded lumps about 1" through from cavities at No. 3 quarry. The mineral is dark grey, with a coarse, incompletely radiated structure, and a tendency for short, curved leaves to spell off from the surface.

QUARTZ: This mineral is rarely seen and no well crystallized specimens have been found. One partly crystallized lump of a very pale amethystine color was found at No. 3 quarry.

AGATE: One small specimen of a pale bluish white color was found at No. 3 quarry. The bands are very numerous, narrow, and all of the same color.

CHALCEDONY: Small bluish white globular masses lining cavities at No. 3 quarry, and more frequently as lenses an inch or two long in the solid trap rock at No. 1 quarry.

CHLORITE: Drusy coatings of green earthy Chlorite occur rarely at No. 1 quarry, and more commonly in tube like cavities filled with a pale green earthy variety. Occasionally this crystallizes in velvety yellowish green tufts inside the cavities, or forms little greenish black radiating fibrous masses. A very rare form consists of minute purplish bronze tufts. Probably several species are present, but at best these minerals are very hard to identify.

CHALCODITE: Minute patches of yellowish bronze scales on Prehnite from No. 3 quarry.

BORNITE: Grains about 1/8" in diameter associated with Stilbite and Albite in the green stone of No. 1 quarry.

CHALCOPYRITE: Tiny lens shaped grains in Calcite and Prehnite from No. 3 quarry.

CHALCOCITE: Grains about 1/8" associated with Stilbite and Albite in the green stone of No. 1 quarry.

CHRYSOCOLLA: Very thin bright green coatings on the copper sulfides and adjacent minerals.

HEMATITE: Brilliant reddish black microscopic crystals on trap rock at No. 3 quarry.

ALTERATION PRODUCT: Round white clay like patches about ¼" in diameter on trap rock from No. 1 and No. 2 quarries were identified as the residue left from solution of a flattened, bladed, and radiated form of Calcite. The origin of these patches was purely a matter of conjecture until a specimen of the Calcite in process of alteration was found. They make interesting and rather odd specimens.

Doubtful Minerals

MESOLITE: White opaque rings around Stilbite and one specimen which looked like an altered Pectolite but proved to be largely Stilbite on testing, were found to consist of an intimate mixture of Stilbite and a white acicular, easily altered mineral. Although this mineral could not be separated for testing it is probably Mesolite forming so-called Sphaerostilbite which Dana showed to be a mixture of Stilbite and Mesolite long ago.

LAUMONTITE: Rounded oval masses of quarry are probably a mixture of Prehnite and Laumontite formed by alteration of the former.

FELDSPAR: A fine granular greyish white opaque mineral filling veinlets in the trap rock of No. 2 quarry proved on analysis to be a fusible anhydrous silicate of lime, iron, soda, and alumina. It seemed to be all one mineral under the microscope by reflected light and is probably a very impure feldspar, or possibly a pyroxene.

Crystal Cavities

ANHYDRITE: Thin rectangular cavities left by the dissolving away of Anhydrite are quite common in Albite and Chlorite from No. 1 quarry and are occasionally found in the Prehnite of No. 3 quarry.

CALCITE: Large well formed cavities left by the dissolving away of some mineral which formed stout crystals of a more or less rhombohedral outline were found in Stevensite, Chabazite, and Stilbite from No. 1 quarry and one group of them in Albite from No. 3 quarry. The original mineral was identified by making casts of the cavities with modeling clay and noting the external form as well as the presence of three sets of grooves running at angles of 120 degrees to each other. Similar grooves are often present on partly weathered Calcite; so that there seems little doubt that that was the original mineral of these cavities.

Relative Age of the Minerals at this Locality

As the author wanted something to do with his collection during the winter, besides wishing for good weather again, he made an attempt to puzzle out the sequence of formation of the above minerals in the following way.

As Albite is a common mineral at Summit and is often closely associated with other minerals, it makes a good starting point. The only minerals older than Albite are Anhydrite which forms lamellar cavities in it, and in one instance, Calcite, which also left cavities in it.

On the other hand, the brown Calcite rests on Albite and the second generation of Calcite in that specimen is still later than the Albite. Crystal cavities after Calcite in Pectolite (now altered to Stevensite), Chabazite, and Stilbite show that there the Calcite was earlier. Other specimens show Calcite resting on Prehnite and Chlorite, (the last named containing an Anhydrite cavity) which would indicate that it was later than those minerals. In still other places it fills large jointing cracks and must, therefore, have formed after the cracks did, thus being quite late. Evidently Calcite formed over a long period of time, being of very early age in some place and probably after all the other minerals in others.

Inclusions of Albite in Stilbit eand Heulandite and a specimen of Chabazite resting on Albite show these zeolites to be later than the Albite, while Stilbite overlays Heulandite and therefore must have formed after that mineral.

The Prehnite and Datolite from No. 3 quarry formed under different conditions from the above mentioned zeolites, but the Prehnite is shown to be of about the same age as Albite by the fact that it contains cavities after Anhydrite. It also rests on crystalline Hematite which, with the sulfides, would form as sublimation products while the rock was still hot. The fact that both Prehnite and Datolite contain a little water indicates that they formed later than Albite, about the time that the very hydrous silicates (zeolites) were beginning to appear, if not earlier. Since Datolite rests on Prehnite, and is very intimately associated with Chalcedony, it must be later than the former and of the same age as the latter.

The Chlorites occurring in tube like cavities at No. 1 quarry contain many cavities after Anhydrite as well as a little Calcite also containing cavities.

As the tubes all occur in solid trap rock, probably from above the zone of greatest alteration, they must have been formed by gas bubbles rising thru the still molten rock and were probably filled with Anhydrite at that time. The Chlorite was formed later, but before conditions arose which would dissolve the Anhydrite. Since no cavities after Anhydrite are found in the zeolites, all of the former must have dissolved before they started to form; so it would seem that the Chlorites are earlier than the zeolites. The calcite is also later than the Chlorite upon which it rests, but not much so, as it too formed around Anhydrite. It may have come from altering Anhydrite in another part of the same tube.

The little white globular Stilbite rests on Stevensite (altered Pectolite) and must have formed after the Pectolite.

Irregular Heulandite crystals in Pectolite kith needles of the latter imbedded along their sides show Pectolite to have been the earlier.

Stilbite intimately associated with massive Natrolite from No. 1 quarry shows that the two minerals are of about the same ago.

Small cavities having Stilbite next the wall and Chabazite inside from the green stone of No. 1 quarry show Chabazite to have been the later.

On the other hand, Laumontite was found close to deeply corroded Stilbite showing that it probably resulted from the alteration of Stilbite under the right conditions.

The copper sulfides occur sometimes in altered green stone and sometimes imbedded in Stilbite next to the green stone. If they are of early formation as seems likely, this would show that the green stone has been replaced to some extent by Stilbite. It may be that nearly all of the Stilbite was derived from something in the green stone.

socolla, Limonite, Stevensite, and probably Laumontite, represent a late stage of development.

A list of the minerals in the approximate order of their formation follows: extent by Stilbite. It may be that nearly GREEN CHLORITE ROCK (ANHYDRITE, Haematite, Chalcopyrite, other sulfides?), CALCITE, (ALBITE, Chlorite), PREHNITE, (DATOLITE, Chalcedony, Agate, Quartz), PECTOLITE, (HEULANDITE, Mesolite), (STILBITE, Natrolite), CHABAZITE, LAUMONTITE, (Calcite, Limonite, Chrysocalla, Stevensite).

The order of the minerals in parentheses is doubtful among themselves. The minerals in large letters are the ones used as reference points. Calcite appears at both ends of the list and probably should be shown in many places between. As Aragonite and Apophyllite have been found only recently, nothing definite can be said of their age relationships.

It is not known whether the green chloritic rock (of No. 1 quarry) altered to its present condition when the basalt first flowed into a body of water, or has since been further altered. Certainly a considerable change took place while it was still hot.

It is interesting to note that, while most authorities think that at Paterson Albite redissolved and entered into the making of zeolites (it is a comparatively rare mineral there), that doesn't seem to have happened at Summit, as the Albite is very abundant though older than the zeolites.

As the order of formation in all parts of the quarry may not have been quite the same and only a few specimens of each mineral showing any age relationships at all were examined, this may not represent what actually happened very closely. However, it seems to the author that the order given is reasonably close to the truth.

"ARE MINERALS ALIVE?"

By WM. SULZER

Former Governor of New York.

When I was a small boy, living on an old farm, at Wheatsheaf, New Jersey, I wandered often in the fields, and the woods, and along the brooks. Nature appealed to me. Everything I saw, and everything I heard, was interesting and educational.

Among the things, in which I was much interested, were rocks, and stones, and pebbles. Whenever I found one that looked odd, or different, I brought it home and put it in my collection, on shelves I had made back of the corn crib. Every day I would study these specimens, and was careful to exclude duplicates. Unfortunately I could not classify them, or tell much about them, and none of the farmers in our neighborhood could give me any satisfactory information. They just thought I was a queer boy.

Little did I dream, at that time, that I was a mineral collector, and studying geology. However, as the years came and went I followed this inclination, and have always been a collector of minerals, and a student of the rocks. They tell the Truth. Nothing has ever interested me so much as Geology. Looking back over a long career I have often wished that I selected Geology, instead of law, as my lifework and profession.

It is my judgment that Geology is the greatest science. It is the most useful, and the most utilitarian. It tells the story of the earth on which we live. The more we find out about "Old Mother Earth" the greater we become in material benefits; in health; in progress; in happiness; and in enlightenment. All that we are, and all that we hope to be, comes from the earth. By the application of brain and brawn to the resources of Nature we make the world richer, and greater, and humanity happier, along the great highways of civilization.

Many years ago I was on Jumbo Mountain, on the West Coast of Prince of Wales Island, Southeastern Alaska. On this mountain there is found almost every mineral known in the world. It is one of the greatest places on earth to study geology and mineralogy. With me on that occasion were Dr. Alfred Brooks, of the United States Geological Survey; Major Henry G. Catlin, one of the foremost mining engineers of his time; and U. S. Senator John P. Jones, of Nevada, a successful mining man, and one of the ablest statesmen of our country.

After our dinner one night we were sitting in front of our cabin, high up on the mountainside, smoking our pipes.

From early boyhood I had the habit of asking questions about matters in which I was interested. In this way I often received valuable information. We had been studying the geology, and mineral resources of Jumbo Mountain, for several weeks. On this night I asked my companions the question: "Are Minerals Alive?" They stared at me. The first to answer was Senator Jones. He said: "Quien sabe?" In reply I said: "Senator, the animal world is alive. The vegetable world is alive. Why not the mineral world?"

Then Major Catlin said that I had propounded a most interesting question; but that he had never given the question sufficient study, as a mining engineer, to deny or affirm the proposition. Dr. Brooks had listened attentively. When I asked him for his opinion he replied: "Sulzer, you have asked one of the greatest questions in science. I have thought about it, but have reached no conclusion. As you have asked the question, perhaps you have given the matter sufficient investigation to vouchsafe an opinion."

"Gentlemen," I said, "You admit you do not know. So far as I am advised no scientist has ever advanced the theory that the mineral world is just as much alive as the animal world, or the vegetable world. I have thought much about it. My opinion is that the mineral world is alive. It is very much older than the vegetable world, and the vegetable world is very much older than the animal world. I believe there has been animal life on our planet for several million years; that there has been vegetable life on our planet for several million years more; and that there has been mineral life on our planet for more than a billion years. Mineral life came first, and paved the way for vegetable life. Vegetable life came second, and paved the way for animal life. Observation, investigation, and deduction prove it beyond peradventure. No mineral life, no vegetable life. No vegetable life, no animal life.

"Minerals are a part of matter, and all matter is alive. The only permanent thing is change. Everything that lives in the stellar universe is subject to this law of change, or as some people say—evolution. Matter is eternal; it is without cause; without origin; and without end. All matter is alive, and in constant flux and motion. Matter is never at rest. Mineral life follows, like everything else, the infinite law of change. Its transmutation, or metamorphosis, is often so slow that the human intellect is incapable of the perception; but change goes on. Mineral atoms, and electrons, like all other life, are subject to this universal law, the potentialities of which are energy, and energy reduced to its final analysis is pure electrons. The conservation of energy, in its various forms, means that matter—all matter—is alive; that it is in constant motion; and forever indestructible. Minerals, which are a part of matter, are alive, and always in motion. There is nothing at rest. The transformations are merely changes from one form of matter to another, and all according to "Old Mother Nature's" great law of Change."

When I finished Dr. Brooks said: "Mr. Sulzer, assuming that you are right, and there is much in your argument, then you have made one of the greatest discoveries in the history of Science."

Since then other scientists have confirmed my conclusions. I have verified them. Therefore I now assert, as a fact, that minerals are alive, and I challenge science to successfully controvert my assertion.

Friedensville Mines May Be Reopened

During the past several weeks, drilling and draining in the old Friedensville mining area of eastern Pennsylvania has led to much speculation concerning the possible reopening of the mines. Altho the New Jersey Zinc Co. are giving out no definite information concerning these operations, it is evident from observation that the work is no idle investigation, but serious prospecting. For the first time in years signs reading NO TRESPASSING have appeared near the old mine holes, and local collectors are hoping that in the not too distant future that the dumps will once more begin to increase rather than diminish, and that the additional material will warrant the securing of permission to pass by the signs, bag and hammer in hand, for some finds such as those reported in the seventies of the last century.

FOSSILS AND FOSSIL COLLECTING

By IRVING G. REIMANN
Buffalo, N. Y.

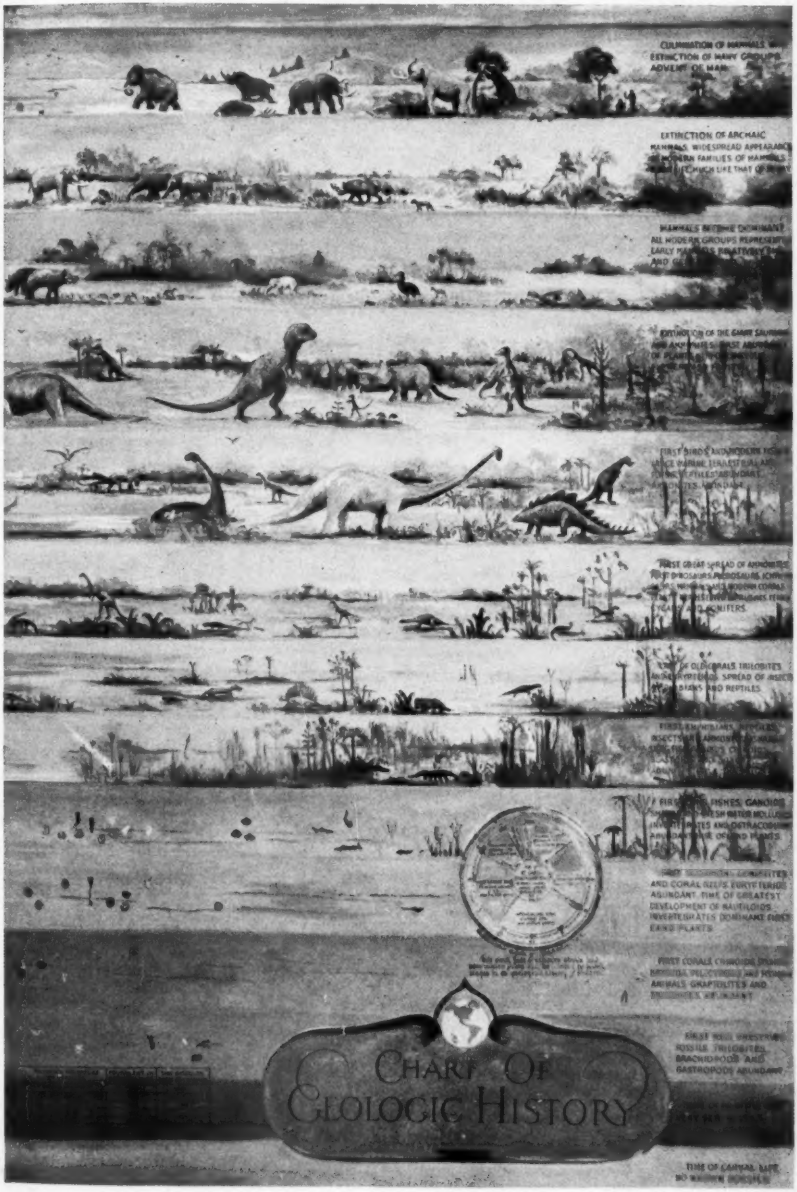
According to definition "a fossil is the remains of an animal or plant, or the evidence of its existence, which has been buried in the rocks of the earth." To this we might add "in prehistoric times." The first part of the definition is easy enough to interpret. Obviously it refers to bones, teeth, shells, stems, and other portions of animals and plants. The second part may require a moment's thought, but what more obvious evidence of a creature's existence could there be than the molds and casts of shells now dissolved away, and the tracks or trails or burrows of creatures whose actual remains are absent? These are all true fossils, but there are other features preserved in the sedimentary rocks which are often called fossil but which the definition rules out. These are the objects of inorganic origin. Typical examples are fossil ripple marks, mud cracks, and raindrop impressions preserved in ancient rock. These are known as pseudo—fossils (pseudo= false). Still another classification might be proposed to include objects frequently mistaken for fossils. These might be called "quasi-fossils" (quasi= similar to), and would include such imitative forms as cone-in-cone structure, sometimes mistaken for teeth, corals, etc.; septaria, often mistaken for fossil turtles; differentially weathered rocks which, like the clouds, offer imaginative people a great field for finding faces, animals, etc. Queerly shaped concretions also contribute many quasi-fossils to the curator's desk; and it is difficult to persuade most people that dendrites are not fossil plants.

In spite of their wide-spread occurrence, fossils remain a mystery to a vast number of well-educated people. Although Buffalo is in the center of a region world famed for its fossils, probably not more than one person in ten has more than a vague notion as to their real nature. Most people doubtless believe that "fossil" is synonomous with "old fogie," and it is reasonable to suppose that this situation is typical of most communities.

The collecting instinct is something every one does not possess. Some have it in a small way, others collect almost everything. Those of us who have been bitten by the geology bug usually find it impossible to entirely confine our interest to any single branch of the subject. Of course, as we progress, we must specialize, but even specialization is aided by a wide background. One thing leads to another, and few mineral collectors who have searched in the sedimentary rocks can have failed to notice fossils—and perhaps collect some.

Few fossils have the beauty of color which renders the minerals so popular, but they are very interesting objects nevertheless. These fossils on my desk aren't beautifully colored, but through the millions of years they have retained their beauty of form. Some of them are completely replaced by calcite, or quartz, but a thin section still shows their microstructure in its original perfection—thanks to metasomatic replacement. They once lived here in a sea, with corals and sharks, but today the nearest sea is five hundred miles distant. In this drawer are some drab fossils which I picked up nearly two miles above sea level—yet they once lived in a sea near the present sea level. Surely they deserve at least passing attention—even if your true love is mineral collecting.

Every science has its own vocabulary, which at the outset may seem terrifying, but which usage reduces to the commonplace. The language of paleontology is no exception, and it contains many words which cannot be avoided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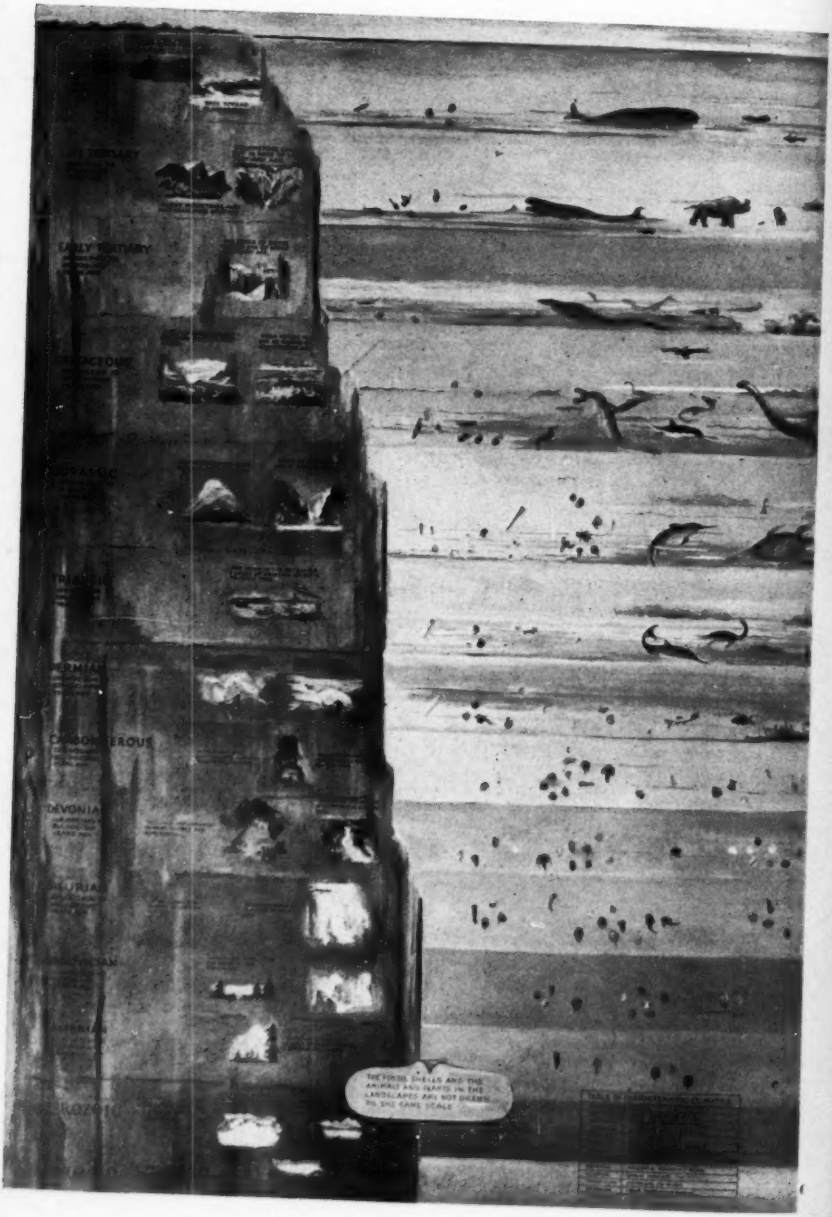
DEVONIAN
THE FOSSIL SHELLS AND THE ANIMALS AND PLANTS IN THE LANDSCAPES ARE NOT DRAWN TO THE SAME SCALE

since they have no common equivalent. Some of them such as "dinasour," have already become a household word, and familiarity renders the worst of them innocuous. Most of the words are derived from Greek or Latin stems. "Paleontology," for instance, is derived from the Greek words "Palaios=ancient, onta=beings, and logos=discourse and means the study of ancient life. "Dinosour" means "terrible lizard" (deinos=terrible and sauros=lizard).

..The word "fossil" is taken from the latin adjective **fossilis** (fodere) which means "dug out of the earth." The same word is the source of the word "fosse," meaning ditch, and "fossa," a biological term meaning a pit or cavity, usually in bone. Thus it is evident that "fossilize" and "petrify" are not synonymous, as is popularly thought. Petrify means to turn to stone, since its derivation is from the Latin **petra,** meaning stone. All fossils are not petrified, and attention will be directed to a few such fossils in forthcoming articles. The fossils of the oldest fossil-bearing rocks are almost invariably petrified, while those of the more recent deposits frequently differ in composition from living organisms only in the loss of the soft tissues through decay. Instances are known of fossil animals having been found in which even the soft tissues are preserved, and next month we shall discuss these.

..It may be appropriate to digress for a moment at this point to discuss briefly the age of some of the sedimentary rocks, as a background for our paleonto'ogical musings. Since many of the readers may not be familiar with the geological time table, an attempt will be made to avoid the use of technical names. For a full discussion of the problem the student will wish to consult Bulletin Number 80 of the National Research Council, published by the National Academy of Science, Washington, D. C., in 1931 (486 pages).

Since the time when the earliest rocks with abundant fossils (Cambrian) were deposited, a thickness of fifty miles of sedimentary rocks have been laid down in North America. Taking into account the probable rate of deposition of the various types of rocks, their thickness, and the length of time represented by breaks in the rock record, the figure of 550,000,000 years was arrived at. A check against this figure was attempted by determining the sodium content of the ocean, but too many hypothetical and unsolved factors led the investigators to consider this method unreliable. The most precise method yet devised for measuring the age of the earth is that which is based upon the disintegration series of uranium and thorium, the end product of which is lead. The rate of disintegration is known; hence by careful analysis of unaltered uranium minera's, the amount of lead contained therein can be determined as well as the amount of uranium. The age can then be ascertained by formula. The formula also allows for the presence of thorium and common lead, the presence of which rendered early attempts inaccurate.

By this method **late** Cambrian broggerite was found to be aged 450,000,000 years, and the greatest age recorded was almost 2,000,000,000 years for Pre-Cambrian uraninite from Russia. Other determinations, too numerous to mention here, were made of rocks of various geological periods, the results of which were consistent with the expectations. More recently (1936) Alfred C. Lane and W. D. Urry by use of the helium method (helium is given off in uranium disintegration) checked the lead ratio method and found a close agreement in their results. Thus we may conclude that life has existed in variety and abundance on the earth for very close to 500,000,000 years, and that its lowly beginning may be traced back into rocks formed a billion years ago.

The Outcome of the Contest

In reply to the question "How Can We Increase the Membership of the Rocks and Minerals Association"', the Contest Editor had most gratifying returns. A great many letters were received, read with much care as to the suggestions offered and the award of 25 mineral specimens was made to Mr. A. H. Harris whose letter is printed below in full:

Contest Editor,
Rocks and Minerals.

I think that one way in which we can increase the membership of the Rocks and Minerals Association is in the formation of Rocks and Minerals Clubs in those cities and towns where a number of members already reside. In order to do this, the members should first learn who belongs to the Association in their city, get together for a preliminary meeting, organize a club, and then plan for enrolling new members.

If some one would get busy and put our Association pin on the market, so that members would buy and wear them, it would then be possible for us to recognize fellow members when we meet them in public. This would also advertise the Association.

Another thing which would help to put the Association on the map are placards, printed in large letters as follows:

Rocks & Minerals
Association
Annual Mineralogical Outing

These should be attached to all cars going to the annual outing. We should also bring as many friends as possible to the outing; try to get them interested in the activities; and then with a little persuasion they might be induced to join the Association.

We would also get very good results if each member were to purchase one or more copies of **Rocks and Minerals** for distribution among friends and acquaintances A little follow up work on our part would result in many new members.

We certainly have a very fine Association and the members should support it. If each member would get but one new member the membership of the Association would be doubled.

My best wishes are extended you in this drive for new members.

A. H. Harris,
12 Frederick St.,
Hartford, Conn.

The judges made their award to Mr. Harris because of his practical suggestions and furthermore because he grasped the intent of the question which was how the Association could best increase that membership.

Quite a number of letters urged making the public mineral conscious by advertising, broadcasting and lecture tours all of which would have to be undertaken by the Secretary of the Association and would involve a large expenditure of money. This of course is the way that many things are put over in these days but it is something that has to be continued persistently and consistently. A few of them have been tried by the magazine but without success.

Several letters disclosed that some of the Association's most interested members were already working to stimulate an interest in mineral collecting even to addressing organizations to which they belong. This is most gratifying and the Secretary herewith extends his most appreciative thanks.

Letters from the following members had one or two suggestions of merit and are worthy of honorable mention: Lowell L. Edgerton, Kingman, Ariz.; Bill Rankin, Cedar Rapids, Iowa; Lee R. Locke, Berwick, Me.; Philip Morrell, Readfield, Me.; Fred L. Hofmann, Holyoke, Mass.; R. G. Ridout, Kansas City, Mo.; Harry C. Grahl, New York. N. Y.; M. Knowlton, East Cleveland. Ohio; R. J. Magri, Jr., Lynchburg, Va.; J. M. Couture, Quebec, Canada.

The Judges.

Club and Society Notes

Rocks and Minerals Association

During the month of January, 1938, 159 members were added to the Association of whom 39 were new members. This increases the membership to 2898.

Six dollars were received as contributions which increases the Association's funds to $38.45.

Peter Zodac, Sec.-Treas.

Outing Directors Wanted

May will soon be here—the month set aside for the Association's national outing. Last year a large number of members participated, under state directors of their respective states. We trust that these directors will again cooperate in the coming outing.

We would like to add more directors to the roster this year. Will members who may be interested in acting as directors for their sections or states send in their names to the Director of Outings, Rocks and Minerals Association, Box 29, Peekskill, N. Y.?

A Proposed Tour In June

Mr. Richmond E. Myers, our energetic Director of Tours, has suggested a tour of the area around the Association's headquarters—Peekskill, N. Y. With Peekskill as a center and with a radius of 100 miles, there are hundreds of mines, quarries, rock outcrops and other localities where interesting minerals may be obtained.

The proposed tour would cover three or five days, starting about June 20th, and would be under the joint direction of Mr. Myers and Peter Zodac. The tentative price per person would be $5.00 per day which would cover all charges, bus, tolls, sleeping accommodations, etc., except meals.

All who may be interested in such a tour are urged to communicate with Mr. Richmond E. Myers, Director of Tours, Rocks and Minerals Association, 222 E. Union St., Bethlehem, Penn., stating their preference for either a three or a five day tour.

Mr. Myers has had a great deal of experience in conducting tours of various kinds not only in the United States but in Germany and other European countries. This should insure a most successful and a most enjoyable mineralogical outing.

Attention Hartford Members

Mr. George P. Robinson, of 16 Simpson St., Hartford, Conn., is endeavoring to form a club in his city as a unit of the Rocks and Minerals Association. We are heartily in favor of the idea and will give him all support possible. We hope our members, residing in and around his city, will do likewise.

Considerable interest is being manifested among unattached clubs relative to affiliation with the Rocks and Minerals Association. If the secretaries of these clubs will write the secretary of the Association, the affiliation may be accomplished without much difficulty, Affiliation with the Rocks and Minerals Association, the world's largest mineralogical society, would bring prestige to any club.

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Bibliographical Notes

Rocks and Minerals—a merit badge pamphlet by Scouter Dr. Daniel T. O'Connell, Assistant Professor of Geology, College of the City of New York.

Here is a clear, simplified, and above all, a scientific approach to a most fascinating subject prepared by a man who, aside from his technical knowledge, has a keen insight in boyology. Unlike most of its contemporaries, the pamphlet assumes no previous knowledge of chemistry, physics, geometry, color appreciation or kindred subjects but treats them as a unit and lowers them to the level of youthful understanding.

Appealing, as it does, to the curiosity of the boy, the pamphlet, through its semi-academic approach, tends to cultivate the "hobby sense" in the reader, which is so inherent in all boys.

What is this intriguing science—the never ending, never tiring study of the native substances of the earth upon which we live? The romantic study of nature in the concrete, the definite, is most fascinating.. Know you the essence of your talcum powder or the composite metals of your fountain pen point? Learn these and more as this science treats the elements as they are, their properties, composition, behavior, structure, classification, and manner of being when transposed into everyday commodities.

This is a subject well worth the pursuit of both Scout and Scouter and as such is recommended for "God so made the world."

Published by the Boy Scouts of America, 2 Park Ave., New York, N. Y., 5x8, 59 pp., many illus., price 20c.

E. W. Maxwell.

Annual Report of the Quebec Bureau of Mines for the Calendar year 1935: Part B, 113 pp., illus.; Part C, 91 pp., illus. Issued by the Bureau of Mines, Quebec, Canada.

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How to Study Minerals, E. S. Dana ..	2.15
Hand Book for the Amateur Lapidary, J. H. Howard	2.00
Dana's Text Book, Wm. E. Ford	5.75
Dana's System of Mineralogy	15.50
Fluorescence of Minerals, Chester B. Slawson	.55
How to Collect Minerals, Peter Zodac	1.00
The Book of Minerals, Dr. A. C. Hawkins	1.50
Fossil Penn Coal Flora of Northern Ill., A. C. Noe. Fine illustrations	1.00
Field Book of Common Rocks, Prof. Fred B. Loomis	3.65
Dana's Manual, Wm. E. Ford	4.25
The World Minerals, L. J. Spencer, 40 colored plates	5.25
Praktikum der Edelsteinkunde. By George O. Wild, Gem Expert of Idar, Germany. Contains most beautiful color plates of gems ever produced. Published in German only. Price.....	2.65
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THE AMATEUR LAPIDARY

Amateur and professional lapidaries are cordially invited to submit contributions and so make this department of interest to all.

POLISH ON FLATS

By ARTHUR KNAPP

The writer recently polished a number of slabs of fossil bone, orbicular jasper, sodalite, Mexican onyx and Swiss lapis. None of these specimens were uniform in hardness and the usual polishing procedure resulted in considerable undercutting of the softer material.

The following procedure resulted in a minimum of undercutting and a high polish.

120 carbo. C. I. Lap.

600 " Tin Lap.

600 " Hand rub on glass plate. Take the glaze off of the glass with 120 carbo. and a piece of quartz. The hand operation with 600 should give a very fine but uniform grain without scratches. On soft materials, oculist's emery may be used, in place of the carbo.

Polishing powder on a pitch lap. Apply shellac to an aluminum sanding disc. Heat the pitch in a pan. Dip the face of the disc into the pitch. Press it on a sheet of glass to level the pitch. This makes a lap about 1/32 inch thick, which is enough. There will be air bubbles but they do no harm. Cut a number of slots across the pitch with a hack saw or a knife.

The polishing powder to be used depends upon the material to be polished. Tripoli works well on fossil bone. The pitch lap is slower than a metal lap but, since scratches are not likely to occur, little time is lost.

Any roofing pitch, which is free from sand, will make a good lap. The same lap was used by the writer for a number of different polishing powders. It appears to wash clean and the surface does not get contaminated, provided it is run very wet and not allowed to heat.

Tin Oxide on Felt. A final touch was given with tin oxide on the edge of a hard felt lap. Undercutting will occur if this operation is prolonged.

In a recent letter, a correspondent made a statement which should be passed on to the beginner. He wrote, "Ninety percent of polishing is in the preparation of the surface." The advanced amateur has found this out after spending many hours trying to polish gems without the proper preparation. The beginner should note the condition of surfaces which have polished readily and should profit by it. For soft materials, 600 carbo. does not give the proper grind on a metal lap. Sometimes fine emery will produce the proper results. For flat surfaces, the use of a glass plate with 600 carbo and a hand rub seems to produce a finer grind.